

## Description

# METHOD AND APPARATUS FOR PERFORMING TARGET SEARCH ON OPTICAL STORAGE DISC

### BACKGROUND OF INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to a method and an apparatus for performing target search on an optical storage disc, and more particularly, to a method and an apparatus for performing target search on an optical storage disc according to a hybrid address signal.

[0003] 2. Description of the Prior Art

[0004] As the data processing speed of computer systems greatly increases and the requirement of more massive data storage is correspondingly introduced, optical storage discs that are cost-effective and compact while having larger storage volumes and high access speeds have become popular storage media. Accordingly, an optical storage

device for accessing the optical storage discs becomes essential and necessary. Digital Versatile Discs (DVDs) and DVD drives are typical of the optical storage discs and optical storage devices mentioned above, respectively. When an optical storage device is going to read specific data within an optical storage disc, the optical storage device firstly performs a target search on the optical storage disc to find a location of the specific data. The optical storage device then compares address information read through an optical pickup module of the optical storage device from the optical storage disc with a target address. If the address information read through the optical pickup module matches with the target address, the target search is complete.

[0005] According to a prior art method of target search, the address information can be address information of physical wobbles on the optical storage disc, i.e. physical addresses. Normally, pre-grooves of a blank optical storage disc include the information of the physical addresses. However, it is not easy to read the physical wobbles if data is already written on the optical storage disc since the data writing process usually degrades the quality of the physical wobbles. As a result, the optical storage de-

vice is either unable to perform the target search or performs the target search inaccurately.

[0006] According to another prior art method of target search, the address information can be address information corresponding to storage information stored within the optical storage disc, i.e. logical addresses. However, the accuracy of the logical addresses corresponds to the accuracy of a location of the storage information stored within the optical storage disc. If data recording shift when writing the storage information to the optical storage disc occurs, the target search performed according to the logical addresses will be inaccurate due to the data recording shift.

[0007] As mentioned above, neither the prior art method of target search according to the physical addresses nor the prior art method of target search according to the logical addresses will ensure that the optical storage device correctly performs the target search.

## **SUMMARY OF INVENTION**

[0008] It is therefore an objective of the present invention to provide a method and an apparatus for performing a target search on an optical storage disc according to a hybrid address signal.

[0009] The present invention provides a method for performing a

target search on an optical storage disc. The optical storage disc stores storage information, and the optical storage disc includes track information. The method includes: generating a first intermediate signal according to a readout signal generated by an optical storage device reading the storage information; generating a second intermediate signal according to the track information carried within the readout signal; generating a hybrid address signal according to the first and second intermediate signals, wherein the hybrid address signal corresponds to the first and second intermediate signals, and the hybrid address signal is synchronized with the second intermediate signal; and performing the target search on the optical storage disc according to the hybrid address signal and a target address set by the optical storage device.

[0010] Accordingly, the present invention further provides a circuit installed in an optical storage device for performing a target search on an optical storage disc. The optical storage disc stores storage information, and the optical storage disc includes track information. The circuit includes: a first signal generator for generating a first intermediate signal according to a readout signal generated by the optical storage device reading the storage information; a

second signal generator for generating a second intermediate signal according to the track information carried within the readout signal; a third signal generator electrically connected to the first and second signal generators for generating a hybrid address signal according to the first and second intermediate signals, wherein the hybrid address signal corresponds to the first and second intermediate signals, and the hybrid address signal is synchronized with the second intermediate signal; and a target search module electrically connected to the third signal generator for performing the target search on the optical storage disc according to the hybrid address signal and a target address set by the optical storage device.

[0011] It is an advantage of the present invention that the present invention method and device generate the hybrid address signal according to physical addresses and logical addresses and perform the target search according to the hybrid address signal so that the present invention provides better performance in contract to the prior art. When interruption of decoding the physical addresses occurs, the present invention method and device continuously generate the second intermediate signal according to a period thereof, i.e. the period of the previously generated

second intermediate signal, so that the hybrid address signal is continuously generated. Therefore, the present invention ensures that the target search performed by the optical storage device according to the hybrid address signal is correct.

[0012] These and other objectives of the present invention will no doubt become obvious to those of ordinary skill in the art after reading the following detailed description of the preferred embodiment that is illustrated in the various figures and drawings.

#### **BRIEF DESCRIPTION OF DRAWINGS**

[0013] Fig.1 is a flowchart of a method for performing a target search according to the present invention.

[0014] Fig.2 is a diagram of a circuit for performing a target search according to the present invention.

[0015] Fig.3 is a diagram of signals of the circuit shown in Fig.2.

[0016] Fig.4 is a diagram of the hybrid address signal's timing error tolerance of the sector identification signal shown in Fig.3.

#### **DETAILED DESCRIPTION**

[0017] Please refer to Fig.1 and Fig.2 for a preferred embodiment of the present invention. Fig.1 is a flowchart of a method

for performing a target search according to the present invention. Fig. 2 illustrates a circuit 201 installed in an optical storage device 200 for performing the target search on an optical storage disc 102. The optical storage device 200 includes a micro-processing unit (MPU) 104 and an optical pickup module 110. In the present embodiment, the optical storage disc 102 is a Digital Versatile Disk (DVD) 102 and the optical storage device 200 is a DVD drive 200, wherein the DVD 102 and the DVD drive 200 are well known in the art. The optical storage disc 102 stores storage information 103s, wherein the storage information 103s includes logical addresses. With a viewpoint regarding modulation format, a readout signal generated by the optical pickup module 110 reading the storage information 103s within the optical storage disc 102 is referred to as an eight to fourteen modulation (EFM) signal. In addition, the optical storage disc 102 includes track information 103t, i.e. information of physical wobbles well known in the art. With a viewpoint regarding waveforms, the readout signal is also referred to as a push-pull signal PP.

[0018] As shown in Fig. 2, the circuit 201 includes a sector identification signal generator 210, a physical synchronization

signal generator 220, a counting module 230, an identification sampler (ID sampler) 240, and a target search module 250. The sector identification signal generator 210 includes a data path unit (DPU) 212 and a sector identification decoder 214. The physical synchronization signal generator 220 includes a slicer 222, a physical address demodulating circuit 224, and a sync pattern decoding circuit 226. The counting module 230 includes a slicer 232, a de-glitch unit 234, and a counter 236. In addition, the ID sampler 240 includes an identification sampling signal generating unit 242 and a hybrid address signal generating unit 244. The present invention method is described using the following steps according to the preferred embodiment, however, the order of the steps is not a limitation to the present invention.

[0019] Step 10a: Demodulate the modulation signal EFM using the DPU 212 to generate a sector synchronization signal DVD\_S0 and a demodulated signal DemEFM.

[0020] Step 10b: Decode the storage information 103s carried within the demodulated signal DemEFM according to the sector synchronization signal DVD\_S0 using the sector identification decoder 214 to generate a sector identification signal SECTOR\_ID, wherein the sector identification

signal SECTOR\_ID includes logical addresses 30000, 30001, ....., etc., each of the logical addresses 30000, 30001, ....., etc. corresponds to one of the sectors 30000, 30001, ....., etc., respectively, and a starting location of each of the logical addresses 30000, 30001, ....., etc. corresponds to a pulse of the sector synchronization signal DVD\_S0, respectively, as shown in Fig.3.

[0021] Step 20a: Slice the push-pull signal PP using the slicer 222 to generate a wobble data signal WOBDATA.

[0022] Step 20b: Demodulate the wobble data signal WOBDATA using the physical address demodulating circuit 224 to generate a channel-bit signal CB corresponding to a physical address.

[0023] Step 20c: Decode the channel-bit signal CB using the sync pattern decoding circuit 226 to generate a physical synchronization signal PHY\_SYNC, wherein when interruption of the wobble data signal WOBDATA together with the channel-bit signal CB occurs, the sync pattern decoding circuit 226 continuously generates the physical synchronization signal PHY\_SYNC according to a period T thereof, i.e. the period T of the previously generated physical synchronization signal PHY\_SYNC shown in Fig.3. The period T shown in Fig.3 corresponds to an Error Correction Code

(ECC) block. In this embodiment, each ECC block corresponds to sixteen sectors.

[0024] Step 30a: Slice the push-pull signal PP using the slicer 232 to generate an unfiltered wobble signal WOBBLE\_woDEG.

[0025] Step 30b: Filter out glitches within the unfiltered wobble signal WOBBLE\_woDEG using the de-glitch unit 234 to generate a filtered wobble signal WOBBLE corresponding to the unfiltered wobble signal WOBBLE\_woDEG.

[0026] Step 30c: Generate a counter value CV according to waveforms of the filtered wobble signal WOBBLE using the counter 236. The counter value CV corresponds to the rise and fall of the waveforms of the wobble signal WOBBLE.

[0027] Step 40a: Generate an identification sampling signal ID\_SAMPLE according to the sector identification signal SECTOR\_ID using the identification sampling signal generating unit 242, wherein the identification sampling signal ID\_SAMPLE includes at least one simplified address 3000 of the logical addresses 30000, 30001, ....., etc., of which the least significant bits (LSB) 0, 1, ....., etc. are omitted, carried within the sector identification signal SECTOR\_ID. In the present embodiment, a starting location of the simplified address 3000 of the identification

sampling signal ID\_SAMPLE corresponds to a location between the logical addresses 30007 and 30008 of the sector identification signal SECTOR\_ID as shown in Fig.3.

[0028] Step 40b: Generate a hybrid address signal Hybrid\_Address according to the identification sampling signal ID\_SAMPLE and the physical synchronization signal PHY\_SYNC using the hybrid address signal generating unit 244, wherein the hybrid address signal Hybrid\_Address includes the simplified addresses 2FFF, 3000, ....., etc. corresponding to the simplified addresses 2FFF, 3000, ....., etc. of the identification sampling signal ID\_SAMPLE. In the present embodiment, starting locations of the simplified addresses 2FFF, 3000, ....., etc. of the hybrid address signal Hybrid\_Address are synchronized with the physical synchronization signal PHY\_SYNC as shown in Fig.3.

[0029] Step 50: Perform the target search on the optical storage disc 102 according to the hybrid address signal Hybrid\_Address and a target address set by the MPU 104 using the target search module 250, wherein the target search module 250 is capable of controlling accuracy of the target search according to the counter value CV.

[0030] Each of the simplified addresses 2FFF, 3000, ....., etc.

mentioned above corresponds to sixteen logical addresses. For example, the simplified address 3000 corresponds to the sixteen logical addresses 30000, 30001, ....., and 3000F. As a result, the simplified address 3000 corresponds to an ECC block 3000. That is, the simplified addresses 2FFF, 3000, ....., etc. carried within the hybrid address signal Hybrid\_Address correspond to ECC blocks 2FFF, 3000, ....., etc., respectively. When the target search module 250 finds the target address in the hybrid address signal Hybrid\_Address, the target search is completed. Furthermore, when the optical storage disc 102 does not store any storage information 103s, the target search module 250 performs the target search according to the counter value CV so that the present invention method and device appropriately operate in such situation.

[0031] Please refer to Fig.3 and Fig.4 at the same time. Fig.4 is a diagram of the hybrid address signal's timing error tolerance of the sector identification signal SECTOR\_ID shown in Fig.3. The hybrid address signal Hybrid\_Address is generated correctly as long as the sector identification signal SECTOR\_ID has a timing error corresponding to a data length within half an ECC block. In the preferred em-

bodiment, a starting location of the logical address 30000 of the sector identification signal SECTOR\_ID shown in Fig.3 is aligned with a pulse of the physical synchronization signal PHY\_SYNC. In this situation, the sector identification signal SECTOR\_ID has no timing error. Suppose that the optical storage disc 102 has been written the storage information 103s by an optical disc burner with poor quality so that a starting location of the logical address 30003 of the sector identification signal SECTOR\_ID is aligned with a pulse of the physical synchronization signal PHY\_SYNC as shown in Fig.4. In this situation, the sector identification signal SECTOR\_ID has a timing error of three sectors. However, in both situations shown in Fig.3 and Fig.4 respectively, the synchronization relationships between the hybrid address signal Hybrid\_Address and the physical synchronization signal PHY\_SYNC are the same. As long as the timing error generated during a writing process of the storage information 103s does not exceed a length corresponding to eight sectors, the hybrid address signal Hybrid\_Address will be generated correctly. As a result, the present invention method and circuit 201 greatly enhance the performance of the optical storage device 200. According to the present invention, the optical

storage device 200 has better tolerance of timing errors of the logical addresses carried within the readout signal due to data recording shift of the optical storage disc 102 in contrast to the prior art. Therefore, it is ensured that the optical storage device 200 accurately performs the target search according to the hybrid address signal Hybrid\_Address.

[0032] In another embodiment of the present invention, a shifted target address is calculated by adding a predetermined value to the target address, and step 50 performs the target search on the optical storage disc 102 by finding the shifted target address in the hybrid address signal Hybrid\_Address. Therefore, the present invention is capable of operating within the characteristic variance of the optical storage device 200 by adjusting the shift target address.

[0033] It is an advantage of the present invention that the present invention method and device generate the hybrid address signal according to physical addresses and logical addresses and perform the target search according to the hybrid address signal so that the present invention provides better performance in contrast to the prior art. When interruption of decoding the physical addresses occurs,

the present invention method and device continuously generate the second intermediate signal according to the period thereof, i.e. the period of the previously generated second intermediate signal, so that the hybrid address signal is continuously generated. Therefore, the present invention ensures that the optical storage device correctly performs the target search according to the hybrid address signal.

[0034] It is another advantage of the present invention that the hybrid address signal will be generated correctly while the sector identification signal having a timing error corresponding to a data length within half an ECC block. Therefore, the optical storage device's tolerance of the timing error ensures that the optical storage device accurately performs the target search according to the hybrid address signal.

[0035] Those skilled in the art will readily observe that numerous modifications and alterations of the device may be made while retaining the teachings of the invention. Accordingly, the above disclosure should be construed as limited only by the metes and bounds of the appended claims.